A REVIEW OF ARCHAEOBOTANY AND PALAEOETHNOBOTANY IN HAWAII

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Archaeobotany has been defined by Ford (1979:299) as the study of plant residues derived from archaeological contexts. Palaeoethnobotany, as a field of inquiry, draws upon several types of archaeobotanical analyses. Wood, phytoliths, pollen, and other plant remains such as seeds, leaves, and tubers are examples of archaeobotanical materials. These remains can provide information of relevance to palaeoethnobotany, but may also contribute to studies of palaeoclimate, palaeobotany, etc. More than a listing of plants and their traditional uses, palaeoethnobotany is the study of past man-plant relationships, emphasizing the dynamics of those relationships through time.

The purpose of this paper is to provide a general overview of the role of archaeobotany in Hawaiian palaeoethnobotany. A brief historical sketch of past archaeobotanical endeavors is provided. Several recent analyses, some unpublished, of pollen, wood, phytoliths, and other plant materials recovered through flotation are summarized. Finally, the problems and potentials of these disparate but related lines of inquiry are discussed.

HISTORICAL OVERVIEW

Macroplant remains were recovered from the first Hawaiian sites to be excavated. Stokes in 1913 collected quantities of plant materials, principally in the form of bundle offerings, from the Kamohio Shrine on Kaho'olawe Island (McAllister 1933). An impressive assemblage of plant-derived artifacts including whole gourds, nets, tapa or bark cloth, ti-leaf sandals, and numerous other items was collected from Nualolo Valley, Kaua'i Island by Soehren in 1964 (ms.). Other early excavations such as those at the Kulio'uo'u Rockshelter, Oahu Island (Emory and Sinoto 1961) and the Waiahukini Rockshelter, Hawai'i Island produced plant materials, although these remain unanalyzed.

Formal identification of archaeobotanical macroremains from Hawaiian sites was initiated by Douglas Yen, B. P. Bishop Museum Ethnobotanist since 1966. Yen provided most of the plant identifications for the archaeological studies listed in Table 1. Several of these assemblages were derived from dry

rockshelters, in particular the Kamohio Shrine, Kaho'olawe Island (McAllister 1933), Anaeho'omalu, S. Kohala (Barrera 1971), several Ka'ahumanu Highway sites, S. Kohala (Rosendahl 1972b, 1973), and Kalahuipua'a, S. Kohala (Kirch 1979), all on Hawaii Island. Assemblages from Kapana Heiau, upper Halawa Valley, Moloka'i Island (Rosendahl 1975), the Kaneohe Mound Site, Oahu (Rosendahl 1976), and the Keae Rockshelter, Anahulu Valley, Oahu (Kirch 1979) are notable because the sites which they derive from are located in areas of high rainfall where plant preservation generally would not be expected.

The first concentrated effort to recover small plant materials was made by Paul Rosendahl (then a student of Yen) at upland Lapakahi, N. Kohala, Hawaii. One-quarter and one-eighth inch wire mesh screens were used in the field for screening cultural deposits, while firehearth contents were removed in bulk and processed in the lab using 1/4, 1/8, and 1/16 inch screens (Rosendahl 1972a:383). Simple water flotation was attempted but proved unsucessful because of the fine powdery soils and the numerous grass rootlets. Among the more remarkable Lapakahi finds were several complete and fragmentary carbonized sweet potato tubers. These tubers were dated to between A.D. 1425 and 1725 and constituted the first direct evidence of prehistoric Hawaiian sweet potato cultivation (Rosendahl and Yen 1971).

RECENT STUDIES

In 1977, an exceptional quantity of archaeobotanical macroremains were recovered by Patrick McCoy (1977) from a rockshelter located at 3,800 m within the Mauna Kea Adz Quarry Complex. The analysis of this assemblage by M. Allen emphasized the functional and behavioral implications of the taxa identified (Allen 1981). Methodologically, particular attention was paid to fine grained sediments and screens of 1/4, 1/8, 1/16, and 1/32 inch mesh were used for processing. Among the fine sediments were seeds of Oxalis corniculata, Daucus sp. and Adenostemma lavenia, all weedy species of which the first two were once believed to have been post-European introductions to Hawai'i. The presence of these seeds in a prehistoric context adds to a growing body of data which documents the impact of the aboriginal Polynesians on the Hawaiian environment (Kirch 1982).

The total Mauna Kea Adz Quarry plant assemblage included 51 taxa, representative of vegetation

communities extending from the coast up to the alpine zone of the rockshelter site. The most abundant archaeobotanical material recovered was taro (Colocasid esculenta) corm fragments. These remains constitute the earliest evidence of taro in Hawaii (Allen 1981:133) and possibly the Pacific (M. Spriggs, pers. comm.). Although taro was found throughout the rockshelter deposit, the earliest samples came from a stratigraphic layer dated to A.D. 1175 + 80 (uncorrected).

Another important ethnobotanical study, conducted by Funk (1979), dealt with fiber plants of the family Urticaceae. Five genera of this family which were known to have been traditionally used by the Hawaiians for tapa and cordage were studied for anatomical characters of their fibers and lacticifers which would allow differentiation between taxa. This research was an important advancement in the identification of plant species used in Hawaiian artifactual materials and significant in its use of defined botanical structures as a basis for these identifications. More studies of this kind should be conducted for other Hawaiian economic plants, especially those used in plaiting, cordage and tapa.

In the last two years contract-funded archaeological research has resulted in an increased interest in various kinds of palaeoenvironmental studies including malacology, palynology, phytolithology, carbonized wood identification, and analysis of macroscopic plant remains recovered through flotation. The Waimea-Kawaihae Road Corridor Project (Clark and Kirch 1983) brought together several specialists in an attempt to document environmental change and prehistoric human impact in this 32 km long corridor from near sea level to approximately 870 m elevation. Unfortunately, pollen, phytoliths and macroscopic plant remains were rather poorly preserved in the corridor sites. The carbonized wood analyses were more productive, however, and evidenced several dryland forest species, some of which are present today on the Waimea Plain only as isolated individuals. Nothocestrum, Canthium, Nototrichium, Chenopodium, Euphorbia, Alphitonia, Acacia and several unidentified but distinct taxa which may include extinct species were recovered (Murakami 1983a).

Wood and flotation samples were also analyzed from upland Kaho'olawe Island hearth features (Murakami 1983b; Allen 1983a). Murakami documents important evidence for a former dryland vegetation community on this now almost denuded and

TABLE 1

COMPARISON OF PUBLISHED HAWAIIAN ARCHAEOBOTANICAL ASSEMBLAGES

CULTIGENS	Kaho'olawe	Kuli'ou'ou	Lapakahi	Anaeho'omalu	Kane'ohe	Halawa	Kalahuipua'a	Anahulu	Ka'ahumanu
Aleurites moluccana									
nut	x	x	x		x	x	x	x	x
kernal								x	
Bamboo	x	x			x	x	x		x
Canarium							x?		
Cocos nucifera									
nut	x	x	x		x		x		x
husk	x			x					
Cordyline - leaves	x	x					x		
Dioscorea alata						x			
Ipomoea batatas			x						
Lagenaria	x	x		x	x		x		x
Musa sp.	x								x?
Nicotiana tabacum	x?								
Pandanus									
leaves	x	x		x	x	x	x		x
fruit	x	x				x		x	
Piper methysticum	x	x					x		
Prunus sp.								x?	
Saccharum sp.	x	x		x	x				x
WILD SPECIES									
Alyxia olivaeformis	x								
Alpinia sp.							x?		
Caesalpinia								x	
Calophyllum					x				
Cibotium		x		x					
Cyperaceae					x				x
Cyperus laevigatus			x						
C. javanicus		x							
Dioscorea bulbifera			x						
Erythrina sp.			x						
Eugenia (or Ficus)								x	
Euphorbia sp.					x				
Ferns	x				x				x

TABLE 1 (CONTINUED)

COMPARISON OF PUBLISHED HAWAIIAN ARCHAEOBOTANICAL ASSEMBLAGES

	Kaho'olawe	Kuli'ou'ou	Lapakahi	Anaeho'omalu	Kane'ohe	Halawa	Kalahuipua'a	Anahulu	Ka'ahumanu
Graminae	x		x		x		x	x	
Hibiscus tiliaceus	x	x			x				
Hypnea nicifica (limu huna)		x							
Lichens					x				
Melia azedarach								x	
Metrosideros sp.	x?				x				
Momordica			x					x	
Morinda citrifolia								x	
Mucuna sp.						x		x?	
Myrsinaceae			x						
Opuntia sp.			x						
Psidium					x			x	
Sicyos sp.			x				x		
Sida		x					x		
Sedge				x					
Thespesia					x		x		

desolate island. Santalum, Canthium, Nototrichium, Nothocestrum, Chenopodium and Bidens (the latter two generally not woody) were among the taxa identified. Only Santalum and Bidens had been previously recorded for Kaho'olawe. Additional wood charcoal analyses are planned in conjunction with the present Kaho'olawe island salvage work recently completed by Rosendahl and will include samples from both the coastal and upland sites. The coastal samples will be particularly important for understanding plant zonation on the island and vegetation changes through time as a result of human impact.

Flotation samples from Kaho'olawe were heavily dominated by seeds of the native shrub/tree Chenopodium (cf. oahuense) (Allen 1983a). This taxon is not found on the island today, although it is generally a weedy plant and the family is known for its colonizing charcteristics. It is hypothesized that the presence of enopodium in both the Kaho'olawe and flotation samples from other areas is a reflection of the role of the plant as a prehistoric agricultural fallow element (Allen 1983a). Quantities of Chenopodium seeds were also recovered from several sites at Kuakini, Kona, Hawai'i (in press) and the Kuakini pollen samples were monopolized by Chenopodium (T. Bennett, in press).

Analysis of flotation samples (Allen 1983b) from a leeward coastal rockshelter at Kalahuipua'a, S. Kohala, Hawaii added considerably to previous archaeobotanical finds from the same site (cf. Kirch 1979). Examination of fine-grained sediments increased by two-fold the number of taxa represented. Most notably, small fragments of taro corm were recovered, documenting Kirch's earlier inference (1979) regarding the interrelationships of Kalahuipua'a residents with upland agricultural populations. The presence of noni (Morinda cf. citrifolia), coconut and kou (Cordia cf. subcordata) suggested purposeful environmental modification by the Kalahuipua'a occupants, as these taxa are generally planted rather than naturally dispersed (Allen 1983b).

Three other recent archaeological studies have included archaeobotanical analyses. Macroremains, wood and several large tapa fragments from sites at Kawela, Molokai have been identified by Allen, Murakami and Funk respectively (in Weisler and Kirch 1982). Excavation of water saturated

deposits at Kawainui Marsh by Allen-Wheeler (1981) included sampling for pollen and macroremains, however, identification and interpretation of both classes of materials was limited (Allen-Wheeler 1981; Ward 1981). A flotation sample from a non-cultural burn layer which appeared during trenching at Kaunakakai, Molokai contained several hundred carbonized seeds (Allen 1982). Unfortunately time and money for additional excavations and analyses were not available.

PROBLEMS AND DIRECTIONS

Palaeoethnobotany in Hawaii and the Pacific is unique from similarly focused studies in temperate environments. Foremost is the problem of preservation. Warm, humid environments favor bacterial decay, not organic preservation. Carbonization can offset this decay in hard, dense ligneous materials such as wood, nutshells, and certain seeds, but excessive heat will destroy soft tissues. The economic plants which dominate Pacific island economies are almost entirely fleshy in nature and without seeds, e.g. taro, sweet potato, banana, and breadfruit. In some Melanesian island economies nuts, such as Canarium and Barringtonia are important dietary elements, but these disappear from island plant rosters as one progresses eastward. In sum, both environmental and cultural factors work against preservation of the more economically important plants in Polynesian archaeological sites.

A second problem revolves around the youthfulness of palaeoenvironmental studies in Hawai'i and the Pacific in general. Comparative collections for pollen, wood, phytoliths and seeds are poorly developed. Questions of what constitute adequate sample sizes for these varied analyses in tropical soils have not been addressed. Pearsall (1983:494) and Rosendahl (1972:383) both noted processing problems for phytoliths and flotation samples respectively when using techniques developed in temperate environments. Differential preservation between species has been suggested by studies to date (Murakami 1983b:182; Bennett 1983) but not systematically investigated. Data from pollen and phytolith assemblages are replete with interpretational difficulties, related at least in part to a poor understanding of local taphonomic processes.

Finally, the biologies of many of the taxa under consideration are not well-known. Production rates and dispersal mechanisms for various fruits, seeds, and pollen are inadequately studied. Growth patterns in woody species and variation in cellular features due to environmental conditions are known for only a few Hawaiian species (see Sastrapradja and Lamoureux 1969). Woody characters within a single individual are known to vary in relation to where the sample is taken (i.e. trunk vs. branch) but the range of this variation and its importance to wood identification has not been studied for most Hawaiian species.

In addition to the above factors, the habitat ranges for many native taxa are poorly defined. The introduction of exotic herbivores in the early 1800s wiped out vast areas of native vegetation before thorough floristic studies were conducted. Joseph Rock, who provided one of the more complete overviews of vegetation patterns of the Hawaiian Islands in the early 1900s (1974:1-87), was working with a much altered and highly fragmented native ecosystem. Studies of relict vegetation and historical documents, such as the research conducted by McEldowney for the Waimaea-Kawaihae road corridor (1983), help to define the distribution of native taxa prior to European contact. As more palaeoenvironmental studies are conducted, patterns will emerge, but these preliminary investigations are conducted in somewhat of a void.

CONCLUSIONS

Palynology, phytolithology and identification of macro-plant remains should become increasingly productive avenues of inquiry as the problems of recovery, identification and interpretation are worked. The most exciting data to date has come from wood-charcoal studies by Murakami. This type of plant remain occurs in most Hawaiian archaeological sites and in varied contexts, i.e. hearths, cooking ovens, and agricultural burn layers. Distinctive features which allow identification are generally preserved in carbonized wood, whereas in seeds carbonization may preserve the structure but destroy important identifying characters including color, surficial patterns, texture, and internal morphology. Unlike the case for pollen and phytolith samples, there is considerably less chance of wood samples being contaminated by modern elements, and the natural and cultural processes which are responsible for charcoal deposition in archaeological sites are more easily factored. Murakami's work has greatly increased our knowledge of prehistoric Hawaiian flora,

particularly in dryland environments, and the potential productivity and advantages of this type study for Hawaiian archaeology are great.

Recent studies and a consideration of problem; relevant to Hawaiian archaeobotany emphasize the value of an interdisciplinary approach to palaeoethnobotanical problems and environmental reconstruction in particular. Archaeologists who di utilize these varied specialized studies should strive to co-ordinate sampling localities and procedures, as well as integrating the analytical results, in order to maximize the information retrieved. Involvement of specialists during the actual fieldwork is important. It is through the joining of these multiple and varied strands of evidence that the most complete understanding of thi dynamics of prehistoric Hawaiian man-plant relationships through time will emerge.

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